

## Complete Listing of Claims

Claim 1 (Currently amended). An isolated or purified cell which is recombinant or genetically modified to contain or co-express

i) a cytidine monophosphate sialic acid (CMP- SA)-synthase gene, wherein said (CMP- SA)-synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3 or

b) a polynucleotide that is at least 90% homologous to the nucleotide sequence represented by SEQ ID NO:3, and

ii) a sialic acid phosphate synthase (SAS) gene, wherein said SAS gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 5 or

b) a polynucleotide that is at least 90% homologous to SEQ ID NO:5, and wherein said cell is capable of producing donor substrate CMP-SA above levels produced before said cell was made recombinant or genetically modified, when provided with N-acetylmannosamine (ManNAc).

Claims 2-47 (Cancelled)

48. (Previously presented) The isolated or purified cell of claim 1, which is an insect cell.

49. (Previously presented) The insect cell of claim 48, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.

50. (Previously presented) The isolated or purified cell of claim 1, which is a yeast cell.

51. (Previously presented) The isolated or purified cell of claim 1, which is a plant cell.

52. (Previously presented) The isolated or purified cell of claim 1, which is a bacterial cell.

53. (Previously presented) The isolated or purified cell of claim 1, which is a fungal cell.

54. (Previously presented) The isolated or purified cell of claim 1, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).

55. (Currently amended) An isolated or purified cell that is recombinant or genetically modified to contain and co-express

i) a CMP-sialic acid synthase gene wherein said (CMP- SA)-synthase gene comprises  
a) a nucleotide sequence represented by SEQ ID NO: 3 or  
b) a polynucleotide that is at least 90% homologous to the nucleotide sequence  
represented by SEQ ID NO:3, and

ii) a sialic acid phosphate synthase (SAS) gene, wherein said SAS gene comprises  
a) a nucleotide sequence represented by SEQ ID NO: 5 or  
b) a polynucleotide that is at least 90% homologous to SEQ ID NO:5, said cell  
producing the donor substrate CMP-SA above a level produced before said cell was made  
recombinant or genetically modified, wherein the donor substrate CMP-SA is CMP-KDN  
(cytidine monophosphate-2-keto-3-deoxy-D-*glycero*-D-*galacto*-nonoic acid).

56. (Previously presented) The isolated or purified cell of claim 1, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

57. (Currently amended) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid synthase gene wherein said (CMP- SA)-synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3 or  
b) a polynucleotide that is at least 90% homologous to the nucleotide sequence  
represented by SEQ ID NO:3, and  
ii) a sialic acid phosphate synthase (SAS) gene, wherein said SAS gene comprises  
a) a nucleotide sequence represented by SEQ ID NO: 5 or  
b) a polynucleotide that is at least 90% homologous to SEQ ID NO:5, to produce a  
donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said  
recombinant or genetically engineered cell line, when provided with N-acetylmannosamine  
(ManNAc).

58. (Previously presented) The isolated or purified cell of claim 57, which is an insect cell.

59. (Previously presented) The insect cell of claim 58, wherein said insect cell is of a species  
selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

60. (Previously presented) The isolated or purified cell of claim 57, which is a yeast cell.

61. (Previously presented) The isolated or purified cell of claim 57, which is a plant cell.

62. (Previously presented) The isolated or purified cell of claim 57, which is a bacterial cell.

63. (Previously presented) The isolated or purified cell of claim 57, which is a fungal cell.

64. (Previously presented) The isolated or purified cell of claim 57, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).

65. (Currently amended) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid synthase gene wherein said (CMP- SA)-synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3 or

b) a polynucleotide that is at least 90% homologous to the nucleotide sequence represented by SEQ ID NO:3, and

ii) a sialic acid phosphate synthase (SAS) gene, wherein said SAS gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 5 or

b) a polynucleotide that is at least 90% homologous to SEQ ID NO:5, to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-*glycero*-D-*galacto*-nonoic acid).

66. (Previously presented) The isolated or purified cell of claim 57 wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

67. (Previously presented) The isolated or purified cell of claim 55, which is an insect cell.

68. (Previously presented) The insect cell of claim 55, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmene acrea*; and,

(d) *Drosophila*.

69. (Previously presented) The isolated or purified cell of claim 55, which is a yeast cell.
70. (Previously presented) The isolated or purified cell of claim 55, which is a plant cell.
72. (Previously presented) The isolated or purified cell of claim 55, which is a bacterial cell.
73. (Previously presented) The isolated or purified cell of claim 55, which is a fungal cell.
74. (Previously presented) The isolated or purified cell of claim 55, which is a mammalian cell.
75. (Previously presented) The isolated or purified cell of claim 55, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.
76. (Previously presented) The isolated or purified cell of claim 65, which is an insect cell.
77. (Previously presented) The insect cell of claim 65, wherein said insect cell is of a species selected from the group consisting of:
- (a) *Spodoptera frugiperda*;
  - (b) *Trichoplusia ni*;
  - (c) *Estigmena acrea*; and,
  - (d) *Drosophila*.
78. (Previously presented) The isolated or purified cell of claim 65, which is a yeast cell.
79. (Previously presented) The isolated or purified cell of claim 65, which is a plant cell.
80. (Previously presented) The isolated or purified cell of claim 65, which is a bacterial cell.

81. (Previously presented) The isolated or purified cell of claim 65, which is a fungal cell.
82. (Previously presented) The isolated or purified cell of claim 65, which is a mammalian cell.
83. (Previously presented) The isolated or purified cell of claim 65, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.
84. (Previously presented) The cell of claim 1 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.
85. (Previously presented) The cell of claim 1 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.
86. (Previously presented) The cell of claim 85, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.
87. (Previously presented) The cell of claim 86, wherein said epimerase is UDP-GlcNAc-2 epimerase.
88. (Previously presented) The cell of claim 86, wherein said epimerase is GlcNAc-2 epimerase.
89. (Previously presented) The cell of claim 57 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.
90. (Previously presented) The cell of claim 57 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.

91. (Previously presented) The cell of claim 90, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.

92. (Previously presented) The cell of claim 91, wherein said epimerase is UDP-GlcNAc-2 epimerase.

93. (Previously presented) The cell of claim 91, wherein said epimerase is GlcNAc-2 epimerase.

94. (Previously presented) The cell of claim 57 wherein said cell also contains SA precursor GlcNAc above endogenous levels as a result of supplementation of cell growth medium with SA precursor GlcNAc.

95. (Previously presented) The cell of claim 1, wherein said cell is a mammalian cell.

96. (Previously presented) The isolated or purified cell of claim 57, which is a mammalian cell.

97. (New) An isolated or purified cell which is recombinant or genetically modified to contain or co-express

i) a cytidine monophosphate sialic acid (CMP- SA)-synthase gene, said CMP-sialic acid synthase gene encoding

a) a polypeptide represented by SEQ ID NO:4 or

b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO: 4; and

ii) a sialic acid phosphate synthase (SAS) gene, said SAS gene encoding

a) a polypeptide represented by SEQ ID NO: 6; or

b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:6; or

c) a polypeptide represented by SEQ ID NO: 8; or

d) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:8;

wherein said cell is capable of producing donor substrate CMP-SA above levels produced before said cell was made recombinant or genetically modified, when provided with N-acetylmannosamine (ManNAc).

98. (New) The isolated or purified cell of claim 97, which is an insect cell.

99. (New) The insect cell of claim 98, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.

100. (New) The isolated or purified cell of claim 97, which is a yeast cell.

101. (New) The isolated or purified cell of claim 97, which is a plant cell.

102. (New) The isolated or purified cell of claim 97, which is a bacterial cell.

103. (New) The isolated or purified cell of claim 97, which is a fungal cell.

104. (New) The isolated or purified cell of claim 97, wherein said cell is a mammalian cell.

105. (New) The isolated or purified cell of claim 97, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).



106. (New) The isolated or purified cell of claim 97 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.

107. (New) The isolated or purified cell of claim 97 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.

108. (New) The isolated or purified cell of claim 107, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.

109. (New) The isolated or purified cell of claim 108 , wherein said epimerase is UDP-GlcNAc-2 epimerase.

110. (New) The isolated or purified cell of claim 108 , wherein said epimerase is GlcNAc-2 epimerase.

111. (New) The isolated or purified cell of claim 97, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

112. (New). An isolated or purified cell which is recombinant or genetically modified to contain or co-express a cytidine monophosphate sialic acid (CMP- SA)-synthase gene encoding the polypeptide represented by SEQ ID NO:4 or a variant polypeptide thereof that contains conservative amino acid substitutions and a sialic acid phosphate synthase (SAS) gene encoding:

i) the polypeptide represented by SEQ ID NO: 6 or a variant polypeptide thereof that contains conservative amino acid substitutions, or

ii) ) the polypeptide represented by SEQ ID NO: 8 or a functional variant polypeptide thereof that contains conservative amino acid substitutions,

wherein said cell is capable of producing donor substrate CMP-SA above levels produced before said cell was made recombinant or genetically modified, when provided with N-

acetylmannosamine (ManNAc).

113. (New) The isolated or purified cell of claim 112, which is an insect cell.

114. (New) The insect cell of claim 113, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmene acrea*; and,

(d) *Drosophila*.

115. (New) The isolated or purified cell of claim 112, which is a yeast cell.

116. (New) The isolated or purified cell of claim 112, which is a plant cell.

117. (New) The isolated or purified cell of claim 112, which is a bacterial cell.

118. (New) The isolated or purified cell of claim 112, which is a fungal cell.

119. (New) The isolated or purified cell of claim 112, wherein said cell is a mammalian cell.

120. (New) The isolated or purified cell of claim 112, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).

121. (New) The isolated or purified cell of claim 112 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.

122. (New) The isolated or purified cell of claim 112 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.

123. (New) The isolated or purified cell of claim 122, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.

124. (New) The isolated or purified cell of claim 123, wherein said epimerase is UDP-GlcNAc-2 epimerase.

125. (New) The isolated or purified cell of claim 123, wherein said epimerase is GlcNAc-2 epimerase.

126. (New) The isolated or purified cell of claim 112, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

127. (New). An isolated or purified cell which is recombinant or genetically modified to contain or co-express

i) a CMP-sialic (CMP-SA) acid synthase gene, wherein said CMP-SA synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:3 under stringent conditions, and

ii) a sialic acid phosphate synthase (SAS) gene wherein said SAS gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 5, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:5 under stringent conditions,

and wherein said cell is capable of producing donor substrate CMP-SA above levels produced before said cell was made recombinant or genetically modified, when provided with N-

acetylmannosamine (ManNAc).

128. (New) The isolated or purified cell of claim 127, which is an insect cell.

129. (New) The insect cell of claim 128, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.

130. (New) The isolated or purified cell of claim 127, which is a yeast cell.

131. (New) The isolated or purified cell of claim 127, which is a plant cell.

132. (New) The isolated or purified cell of claim 127, which is a bacterial cell.

133. (New) The isolated or purified cell of claim 127, which is a fungal cell.

134. (New) The isolated or purified cell of claim 127, wherein said cell is a mammalian cell.

135. (New) The isolated or purified cell of claim 127, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).

136. (New) The isolated or purified cell of claim 127 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.

137. (New) The isolated or purified cell of claim 127 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.

138. (New) The isolated or purified cell of claim 137, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.

139. (New) The isolated or purified cell of claim 138, wherein said epimerase is UDP-GlcNAc-2 epimerase.

140. (New) The isolated or purified cell of claim 138, wherein said epimerase is GlcNAc-2 epimerase.

141. (New) The isolated or purified cell of claim 127, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

142. (New) An isolated or purified cell that is recombinant or genetically modified to contain and co-express

- i) a cytidine monophosphate sialic acid (CMP- SA)-synthase gene, said CMP-sialic acid synthase gene encoding

- a) a polypeptide represented by SEQ ID NO:4 or

- b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO: 4, and

- ii) a sialic acid phosphate synthase (SAS) gene, said SAS gene encoding

- a) a polypeptide represented by SEQ ID NO: 6; or

- b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:6; or

- c) a polypeptide represented by SEQ ID NO: 8; or

- d) a polypeptide that is at least 90% homologous to the polypeptide represented by

SEQ ID NO:8;

said cell producing the donor substrate CMP-SA above a level produced before said cell was made recombinant or genetically modified, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-*glycero-D-galacto-nonoic acid*).

143. (New) The isolated or purified cell of claim 142, which is an insect cell.

144. (New) The insect cell of claim 143, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.

145. (New) The isolated or purified cell of claim 142, which is a yeast cell.

146. (New) The isolated or purified cell of claim 142, which is a plant cell.

147. (New) The isolated or purified cell of claim 142, which is a bacterial cell.

148. (New) The isolated or purified cell of claim 142, which is a fungal cell.

149. (New) The isolated or purified cell of claim 142, which is a mammalian cell.

150. (New) The isolated or purified cell of claim 142, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

151. (New) An isolated or purified cell that is recombinant or genetically modified to contain and co-express

i) a CMP-sialic acid (CMP-SA) synthase gene, wherein said (CMP-SA) synthase gene encodes

a) the polypeptide represented by SEQ ID NO:4 or

b) a variant of the polypeptide represented by SEQ ID NO:4 that contains conservative amino acid substitutions; and

ii) a sialic acid phosphate synthase (SAS) gene, said (SAS) gene encoding:

a) the polypeptide represented by SEQ ID NO: 6; or

b) a variant of the polypeptide represented by SEQ ID NO:6 that contains conservative amino acid substitutions; or

c) the polypeptide represented by SEQ ID NO: 8; or

d) a variant of the polypeptide represented by SEQ ID NO: 8 that contains conservative amino acid substitutions,

said cell producing the donor substrate CMP-SA above a level produced before said cell was made recombinant or genetically modified, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-glycero-D-galacto-nonoic acid).

152. (New) The isolated or purified cell of claim 151, which is an insect cell.

153. (New) The insect cell of claim 152, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.

154. (New) The isolated or purified cell of claim 151, which is a yeast cell.

155. (New) The isolated or purified cell of claim 151, which is a plant cell.

156. (New) The isolated or purified cell of claim 151, which is a bacterial cell.

157. (New) The isolated or purified cell of claim 151, which is a fungal cell.

158. (New) The isolated or purified cell of claim 151, which is a mammalian cell.

159. (New) The isolated or purified cell of claim 151, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

160. (New) An isolated or purified cell that is recombinant or genetically modified to contain and co-express

i) a CMP-sialic acid synthase gene, wherein said CMP-sialic acid synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:3 under stringent conditions, and

ii) a sialic acid phosphate synthase gene wherein said sialic acid phosphate synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 5, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:5 under stringent conditions,

said cell producing the donor substrate CMP-SA above a level produced before said cell was made recombinant or genetically modified, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-*glycero*-D-*galacto*-nonoic acid).

161. (New) The isolated or purified cell of claim 160, which is an insect cell.



162. (New) The insect cell of claim 161, wherein said insect cell is of a species selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

163. (New) The isolated or purified cell of claim 160, which is a yeast cell.

164. (New) The isolated or purified cell of claim 160, which is a plant cell.

165. (New) The isolated or purified cell of claim 160, which is a bacterial cell.

166. (New) The isolated or purified cell of claim 160, which is a fungal cell.

167. (New) The isolated or purified cell of claim 160, which is a mammalian cell.

168. (New) The isolated or purified cell of claim 160, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

169. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

- i) a cytidine monophosphate sialic acid (CMP- SA)-synthase gene, said CMP-SA synthase gene encoding
  - a) a polypeptide represented by SEQ ID NO:4 or
  - b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO: 4, and
- ii) a sialic acid phosphate synthase (SAS) gene, said SAS gene encoding

- a) a polypeptide represented by SEQ ID NO: 6; or
- b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:6; or
- c) a polypeptide represented by SEQ ID NO: 8; or
- d) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:8;

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, when provided with N-acetylmannosamine (ManNAc).

170. (New) The isolated or purified cell of claim 169, which is an insect cell.

171. (New) The insect cell of claim 170, wherein said insect cell is of a species selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

172. (New) The isolated or purified cell of claim 169, which is a yeast cell.

173. (New) The isolated or purified cell of claim 169, which is a plant cell.

174. (New) The isolated or purified cell of claim 169, which is a bacterial cell.

175. (New) The isolated or purified cell of claim 169, which is a fungal cell.

176. (New) The isolated or purified cell of claim 169, which is a mammalian cell.

177. (New) The isolated or purified cell of claim 169, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).

178. (New) The isolated or purified cell of claim 169 wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

179. (New) The cell of claim 169 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.

180. (New) The cell of claim 169 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.

181. (New) The cell of claim 180, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.

182. (New) The cell of claim previous 181 wherein said epimerase is UDP-GlcNAc-2 epimerase.

183. (New) The cell of claim previous 181, wherein said epimerase is GlcNAc-2 epimerase.

184. (New) The cell of claim 169 wherein said cell also contains SA precursor GlcNAc above endogenous levels as a result of supplementation of cell growth medium with SA precursor GlcNAc.

185. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid (CMP-SA) synthase gene, wherein said (CMP-SA) synthase gene encodes

a) the polypeptide represented by SEQ ID NO:4 or

b) a variant of the polypeptide represented by SEQ ID NO:4 that contains conservative amino acid substitutions; and

ii) a sialic acid phosphate synthase (SAS) gene, said (SAS) gene encoding:

- a) the polypeptide represented by SEQ ID NO: 6; or
- b) a variant of the polypeptide represented by SEQ ID NO:6 that contains conservative amino acid substitutions; or
- c) the polypeptide represented by SEQ ID NO: 8; or
- d) a variant of the polypeptide represented by SEQ ID NO: 8 that contains conservative amino acid substitutions,

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, when provided with N-acetylmannosamine (ManNAc).

186. (New) The isolated or purified cell of claim 185, which is an insect cell.

187. (New) The insect cell of claim 186, wherein said insect cell is of a species selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

188. (New) The isolated or purified cell of claim 185, which is a yeast cell.

189. (New) The isolated or purified cell of claim 185, which is a plant cell.

190. (New) The isolated or purified cell of claim 185, which is a bacterial cell.

191. (New) The isolated or purified cell of claim 185, which is a fungal cell.
192. (New) The isolated or purified cell of claim 185, which is a mammalian cell.
193. (New) The isolated or purified cell of claim 185, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).
194. (New) The isolated or purified cell of claim 185 wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.
195. (New) The cell of claim 185 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.
196. (New) The cell of claim 185 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.
197. (New) The cell of claim 196, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.
198. (New) The cell of claim 197, wherein said epimerase is UDP-GlcNAc-2 epimerase.
199. (New) The cell of claim 197, wherein said epimerase is GlcNAc-2 epimerase.
200. (New) The cell of claim 185 wherein said cell also contains SA precursor GlcNAc above endogenous levels as a result of supplementation of cell growth medium with SA precursor GlcNAc.

201. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid synthase gene, wherein said CMP-sialic acid synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 3, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:3 under stringent conditions, and

ii) a sialic acid phosphate synthase gene wherein said sialic acid phosphate synthase gene comprises

a) a nucleotide sequence represented by SEQ ID NO: 5, or

b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:5 under stringent conditions,

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, when provided with N-acetylmannosamine (ManNAc).

202. (New) The isolated or purified cell of claim 201, which is an insect cell.

203. (New) The insect cell of claim 202, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmene acrea*; and,

(d) *Drosophila*.

204. (New) The isolated or purified cell of claim 201, which is a yeast cell.

205. (New) The isolated or purified cell of claim 201, which is a plant cell.

206. (New) The isolated or purified cell of claim 201, which is a bacterial cell.
207. (New) The isolated or purified cell of claim 201, which is a fungal cell.
208. (New) The isolated or purified cell of claim 201, which is a mammalian cell.
209. (New) The isolated or purified cell of claim 201, wherein the donor substrate CMP-SA is CMP-Neu5Ac (cytidine monophosphate-*N*-acetylneuraminic acid).
210. (New) The isolated or purified cell of claim 201 wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.
211. (New) The cell of claim 201 wherein said cell is provided with ManNAc by addition of ManNAc to media in which said cell is grown.
212. (New) The cell of claim 201 wherein said cell is provided with ManNAc by genetically engineering said cell to catalyze synthesis of ManNAc.
213. (New) The cell of claim 212, wherein said cell is genetically engineered to contain or express an epimerase that synthesizes ManNAc.
214. (New) The cell of claim 213, wherein said epimerase is UDP-GlcNAc-2 epimerase.
215. (New) The cell of claim 213, wherein said epimerase is GlcNAc-2 epimerase.
216. (New) The cell of claim 201 wherein said cell also contains SA precursor GlcNAc above endogenous levels as a result of supplementation of cell growth medium with SA precursor GlcNAc.

217. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a cytidine monophosphate sialic acid (CMP- SA)-synthase gene, said CMP-SA synthase gene encoding

a) a polypeptide represented by SEQ ID NO:4 or

b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO: 4, and

ii) a sialic acid phosphate synthase (SAS) gene, said SAS gene encoding

a) a polypeptide represented by SEQ ID NO: 6; or

b) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:6; or

c) a polypeptide represented by SEQ ID NO: 8; or

d) a polypeptide that is at least 90% homologous to the polypeptide represented by SEQ ID NO:8;

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-*glycero*-D-*galacto*-nonoic acid).

218. (New) The isolated or purified cell of claim 217, which is an insect cell.

219. (New) The insect cell of claim 218, wherein said insect cell is of a species selected from the group consisting of:

(a) *Spodoptera frugiperda*;

(b) *Trichoplusia ni*;

(c) *Estigmena acrea*; and,

(d) *Drosophila*.



220. (New) The isolated or purified cell of claim 217, which is a yeast cell.

221. (New) The isolated or purified cell of claim 217, which is a plant cell.

222. (New) The isolated or purified cell of claim 217, which is a bacterial cell.

223. (New) The isolated or purified cell of claim 217, which is a fungal cell.

224. (New) The isolated or purified cell of claim 217, which is a mammalian cell.

225. (New) The isolated or purified cell of claim 217, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

226. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid (CMP-SA) synthase gene, wherein said (CMP-SA) synthase gene encodes

a) the polypeptide represented by SEQ ID NO:4 or

b) a variant of the polypeptide represented by SEQ ID NO:4 that contains conservative amino acid substitutions; and

ii) a sialic acid phosphate synthase (SAS) gene, said (SAS) gene encoding:

a) the polypeptide represented by SEQ ID NO: 6; or

b) a variant of the polypeptide represented by SEQ ID NO:6 that contains conservative amino acid substitutions; or

c) the polypeptide represented by SEQ ID NO: 8; or

d) a variant of the polypeptide represented by SEQ ID NO: 8 that contains conservative amino acid substitutions,

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line

corresponding to said recombinant or genetically engineered cell line, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-glycero-D-galacto-nononic acid).

227. (New) The isolated or purified cell of claim 226, which is an insect cell.

228. (New) The insect cell of claim 227, wherein said insect cell is of a species selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

229. (New) The isolated or purified cell of claim 226, which is a yeast cell.

230. (New) The isolated or purified cell of claim 226, which is a plant cell.

231. (New) The isolated or purified cell of claim 226, which is a bacterial cell.

232. (New) The isolated or purified cell of claim 226, which is a fungal cell.

233. (New) The isolated or purified cell of claim 226, which is a mammalian cell.

234. (New) The isolated or purified cell of claim 226, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.

235. (New) An isolated or purified cell from a recombinant or genetically engineered cell line which contains and co-expresses

i) a CMP-sialic acid synthase gene, wherein said CMP-sialic acid synthase gene comprises

- a) a nucleotide sequence represented by SEQ ID NO: 3, or
- b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:3 under stringent conditions, and

ii) a sialic acid phosphate synthase gene wherein said sialic acid phosphate synthase gene comprises

- a) a nucleotide sequence represented by SEQ ID NO: 5, or
- b) a polynucleotide that hybridizes to the nucleotide sequence represented by SEQ ID NO:5 under stringent conditions,

to produce a donor substrate CMP-SA at a higher level than a cell from a parent cell line corresponding to said recombinant or genetically engineered cell line, wherein the donor substrate CMP-SA is CMP-KDN (cytidine monophosphate-2-keto-3-deoxy-D-*glycero*-D-*galacto*-nonoic acid).

236. (New) The isolated or purified cell of claim 235, which is an insect cell.

237. (New) The insect cell of claim 236, wherein said insect cell is of a species selected from the group consisting of:

- (a) *Spodoptera frugiperda*;
- (b) *Trichoplusia ni*;
- (c) *Estigmena acrea*; and,
- (d) *Drosophila*.

238. (New) The isolated or purified cell of claim 235, which is a yeast cell.

239. (New) The isolated or purified cell of claim 235, which is a plant cell.

240. (New) The isolated or purified cell of claim 235, which is a bacterial cell.

241. (New) The isolated or purified cell of claim 235, which is a fungal cell.

242. (New) The isolated or purified cell of claim 235, which is a mammalian cell.

243. (New) The isolated or purified cell of claim 235, wherein said CMP-sialic acid synthase gene and said sialic acid phosphate synthase gene are isolated from a human source.